1977-1978 WINTER TEST SITE REPORT FOR PERIPHERAL PARKING AREAS

XIII OLYMPIC WINTER GAMES · LAKE PLACID · 1980

PREPARED FOR OLYMPIC TRANSPORTATION COMMITTEE

SOIL MECHANICS BUREAU
NEW YORK STATE
DEPARTMENT OF TRANSPORTATION

SEPTEMBER 1978

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INTRODUCTION

The Transportation Inventory report for the XIII Olympic Winter Games defined the need for temporary parking facilities during and possibly immediately after the games. It is anticipated that these parking areas will be located adjacent to the main travel corridors. During the winter of 1977-78, the Olympic Transportation Committee conducted a modest test site program to investigate the most economical and practical methods for the design, construction, operation and restoration of these temporary parking areas. The program was developed with the following objectives:

1. The cost of the facilities will be minimal.
2. The parking surface must be stable under all possible weather conditions that may occur.
3. The methods selected for constructing and operating the parking areas must be environmentally acceptable.
4. The sites shall be restored to their original condition after the completion of the games.

The test sites were designed to conduct field tests on all possible methods of treatment that would meet the program objectives. Prior to the test an investigation was conducted to determine the current state-of-the-art for constructing winter parking surfaces and roads. The U. S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory in Hanover, New Hampshire, provided valuable technical assistance from

extensive experience in the construction of snow roads and airfields in the Polar Regions. Also, technical reports on the construction of compacted snow parking areas for the 1960 Winter Olympics at Squaw Valley, California, were reviewed. This work was conducted by the U. S. Naval Civil Engineering Laboratory, Port Hueneme, California. A synopsis of the information gained from these sources is included in Appendix A.

TEST SITE PLAN

During the winter of 1977-78 two test sites were constructed to determine the types of parking surfaces that would satisfy the project objectives. These surfaces were observed under test traffic through the range of climatic conditions that could potentially occur during the 1980 Winter Olympics. Serviceability was determined by periodically driving and parking trucks and automobiles on the various areas, then observing and recording performance for both traction and support behavior. Climatic data including daily maximum and minimum temperature, and weekly snow and frost depth measurements were made at the test sites and also at two other locations on travel corridors to Lake Placid. Figure 1 shows the location of the project activities.

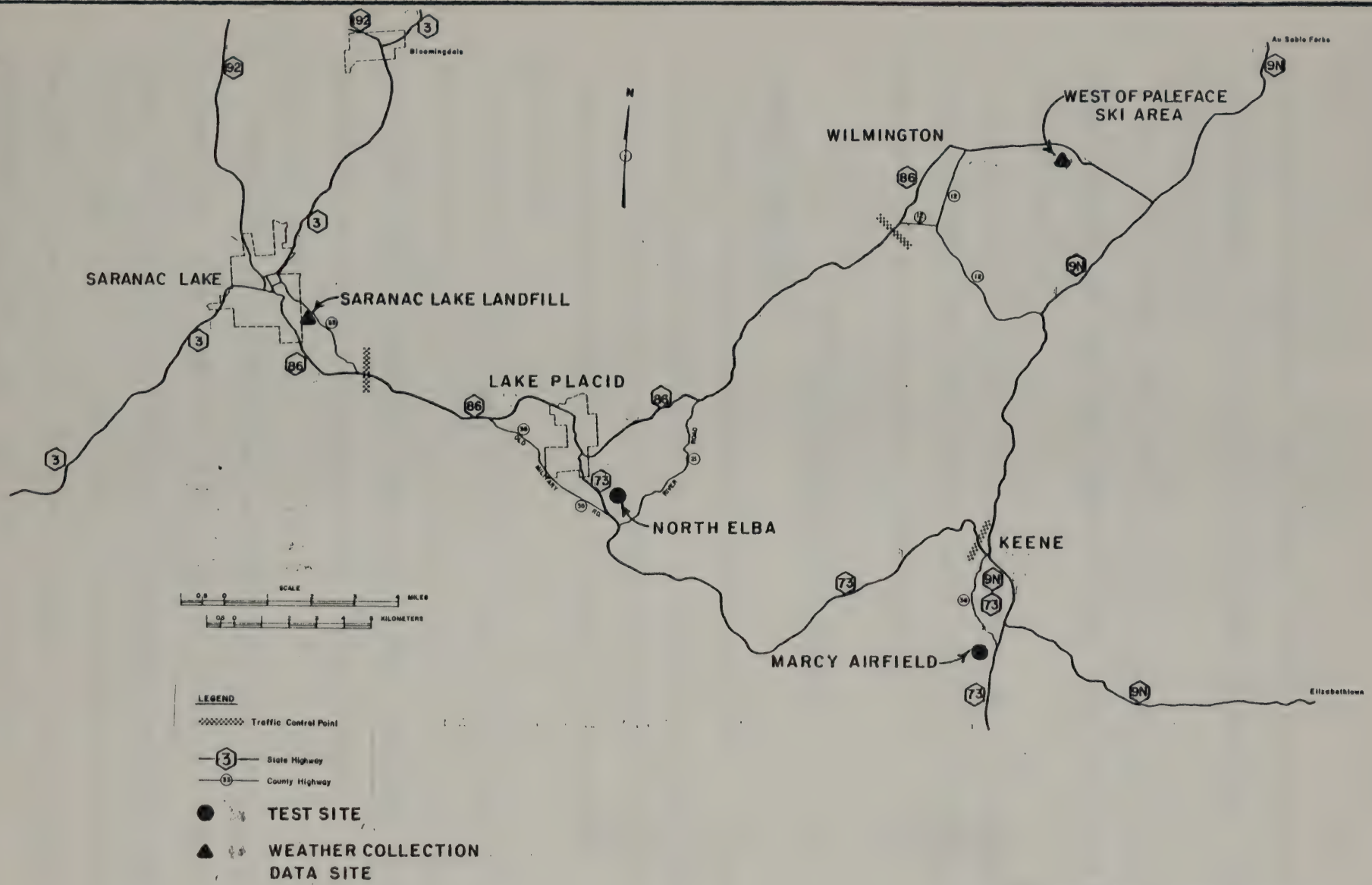
The principal test site was located on the Horseshow Grounds behind the North Elba Town Highway facility and south of the Lake Placid Airport. This site was selected for convenience of access of equipment. The site has the desirable physical characteristics of being level, well drained, and has a thin layer of grass and topsoil over stable granular soil. The basic treatments used were 1.) a gravel pad, 2.) bare ground, and 3.) compacted snow. Sawdust was used on portions of the bare ground and compacted snow to investigate its effectiveness as an insulator during thawing conditions. Portions

extensive experiences in the construction of base roads and airfields in the Fuller Kaplows. Also, technical reports on the construction of temporary snow packing areas for the 1960 Winter Olympics at Squaw Valley, California, were reviewed. This work was conducted by the U. S. Naval Civil Engineering Laboratory, Port Hueneme, California. A synopsis of the laboratory general data study results is included in Appendix A.

TEST SITE SELECTION

During the winter of 1977-78 two test sites were constructed in Greenlee County of parking surfaces that would satisfy the project objectives. These surfaces were designed under real traffic through the range of climatic conditions that could potentially occur during the 1978 winter Olympics. Serviceability was determined by periodically driving the parking areas and surveying the various areas. This observing and recording procedure was both qualitative and quantitative. Climatic data including daily maximum and minimum temperatures, and weekly snow and frost depth measurements were made at the test sites and also at two other locations on the Fort Apache Indian Reservation. Figure 1 shows the location of the project activities.

The principal test site was located on the Greenlee County Grounds behind the County Sheriff's Office and south of the Lake Fork Airport. This site was selected for convenient of access of equipment. The site has the desirable physical characteristics of being level, well drained, and has a thin layer of gravel and topsoil over sandy granular soil. The basic construction used was (1) a gravel base, (2) base course, and (3) compacted soil. Another use used as portions of the base course and commercial zone to investigate the effectiveness as an insulator against freezing conditions. Previous



XIII WINTER OLYMPIC GAMES
PERIPHERAL PARKING TEST SITE PROGRAM
1977 - 78
TEST AND WEATHER COLLECTION DATA SITES

FIGURE I

of the gravel were placed on filter fabric to evaluate its benefits in the cleanup operation. A location plan of the basic treatments and variations is shown on Figure 2.

A smaller secondary test site was located at the east end of Marcy Airport opposite the Keene Town Highway Facility. The test details are shown on Figure 3.

The sites were ready for operation by December 1977. Performance testing and observations were conducted until the first week of April in order to obtain data under complete thaw conditions.

RESULTS OF TEST PROGRAM - 1977-78

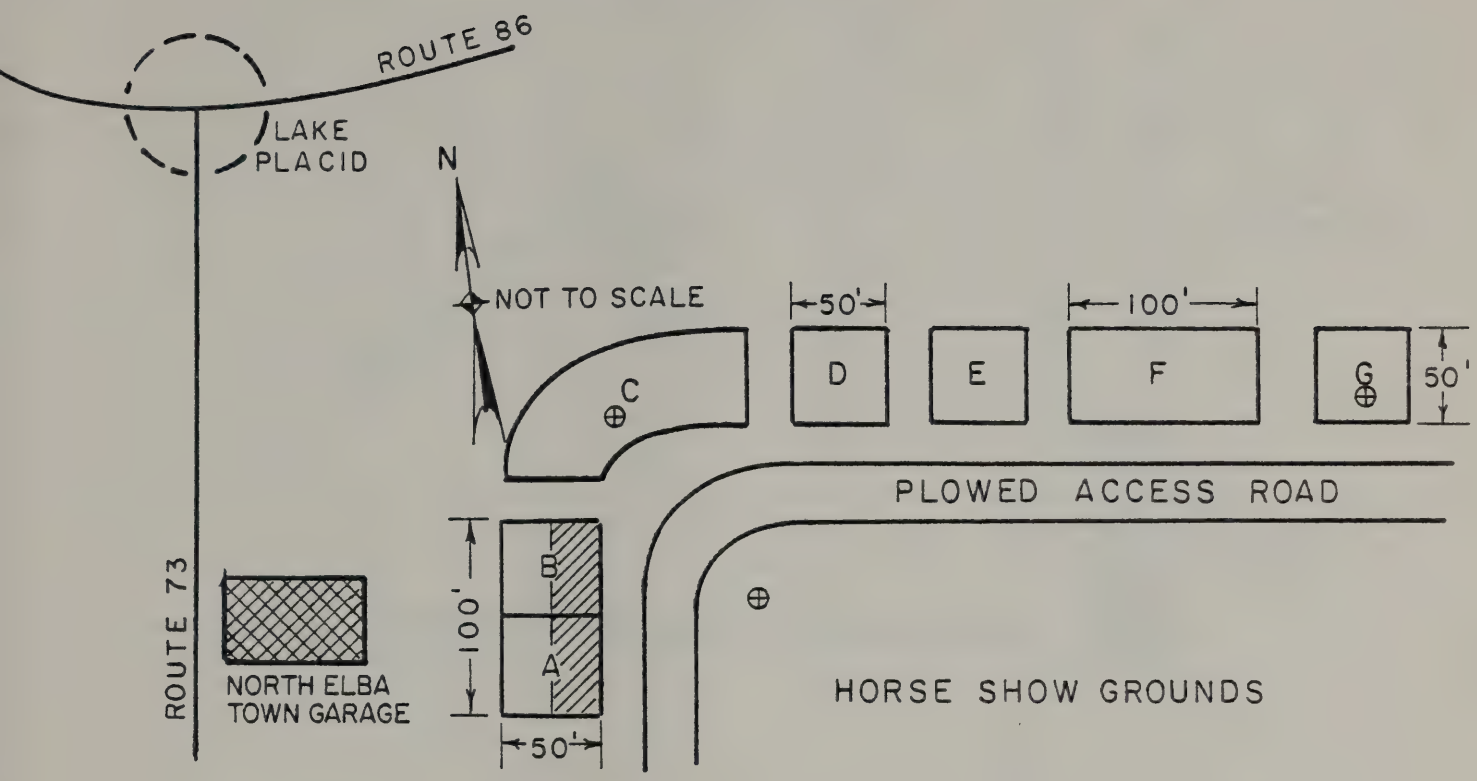
CLIMATIC CONDITIONS

Records of the temperature, snow depth and frost depth at the test sites were made to relate performance of the test sections to climatic conditions. Historical records were analyzed to determine the most adverse thaw conditions that could be anticipated during the period of operation in February 1980.

The New York State Atmospheric Science Center has published the historical records for the period of the Winter Olympic Games. The average high temperature is 25°F and the average low temperature is 8°F. The absolute maximum temperature recorded in this period is 50°F. Snowfall averages 10.9 inches on a 12 inch base.

The detailed climatic observations from each of the four sites are included in Appendix B. Frost gauges, each consisting of a five foot length of pipe casing and a retractable insert tube of clear plastic containing methylene blue dye, were installed at each site. The dye turns colorless when frozen. The depth of frost could be determined by the depth of color change. The approximate frost depths under snow cover were as follows:

NORTH ELBA TEST SITE
TEST DETAILS - 1977-78



⊕ Frost Gauge

A Twelve inches compacted gravel on bare ground and on Filter Fabric

B Six inches compacted gravel on bare ground and on Filter Fabric

C Bare ground - kept plowed all winter

D Bare ground - sawdust cover

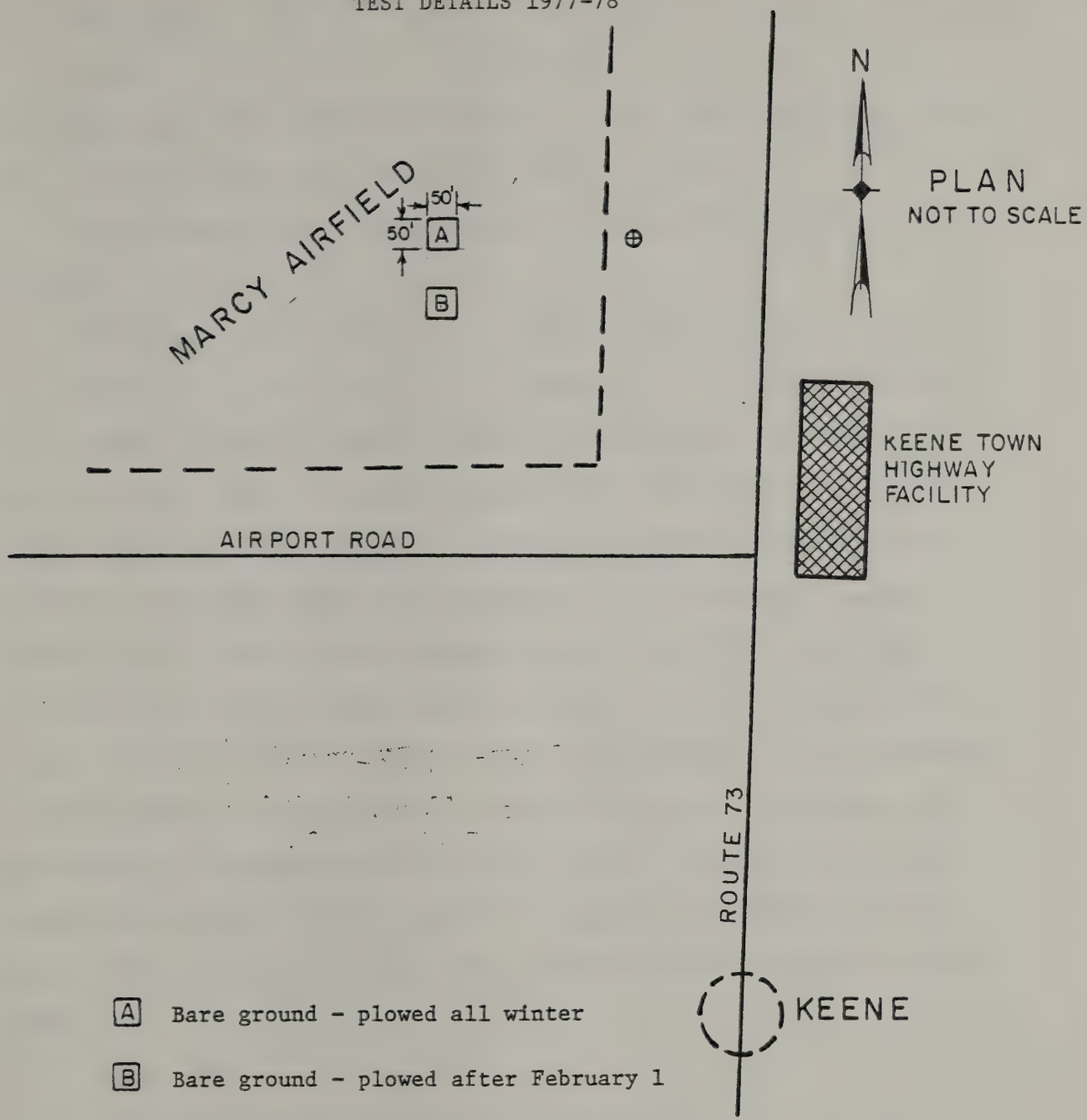
E Compacted snow - sawdust - snow surface

F Compacted snow

G Bare ground - plowed after February 1

FIGURE 2

MARCY AIRFIELD TEST SITE
LOCATION - EAST END OF AIRPORT
OPPOSITE KEENE TOWN HWY. FACILITY
TEST DETAILS 1977-78



A Bare ground - plowed all winter

B Bare ground - plowed after February 1

⊕ Frost Gauge

FIGURE 3

North Elba - 1 ft. Marcy Field - 1/2 ft.

Paleface - 1/2 ft. Saranac - 1 ft.

The approximate frost depths at North Elba in the area plowed after February 1 was 2 feet and in the area plowed all winter - 3 feet.

The approximate snow depths measured from January through March varied as follows:

North Elba - 1 ft. to 2 ft. Marcy Field - 1 ft. to 3 ft.

Paleface - 1 ft. to 3 ft. Saranac - 2 ft. to 2-1/2 ft.

The most critical climatic conditions affecting the performance of the parking surface will be during a thaw period. These climatic conditions can be measured by the magnitude of temperature above freezing and the number of consecutive days with temperatures above freezing. During February 1978, above freezing temperatures were recorded on one day. This was unusual since temperature records for the last 15 years at Marble Lodge, Whiteface Mountain indicate there is an average of 3 days in February when the maximum daily temperature is above 40°F and 6.5 days when the maximum daily temperature is between 32° and 40°F. A graphical maximum temperature summary chart is included in Appendix B. Figure 4 shows the days on which temperatures were above 32°F at the North Elba Test Site in 1978.

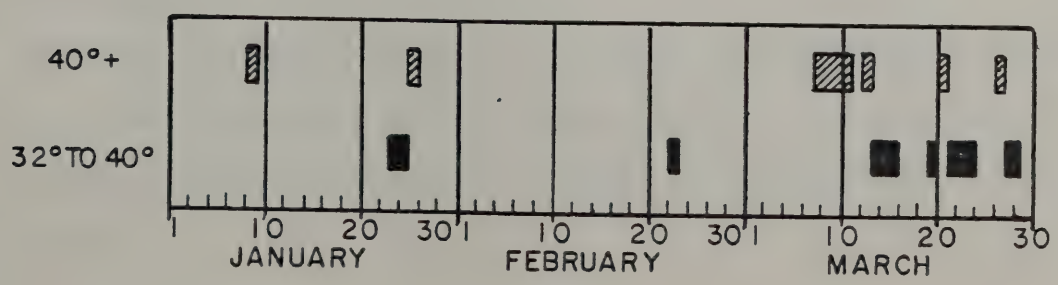


Figure 4 - Maximum Temperatures Above 32°F at North Elba Test Site

The first extended thaw did not occur until March 8-15. The performance of the test sections in this period could be considered as the most unfavorable thaw conditions that could be expected during the period of the Olympics in February. Records of the historical temperature data for the Lake Placid area are included in Appendix B.

TEST SITE PREPARATION - HORSESHOW GROUNDS, NORTH ELBA

The sections were constructed in sequence as shown on Figure 2. The gravel sections, 6 inches and 12 inches thick, were placed in November. A filter fabric, 25 feet wide and 100 feet long, was placed on the ground surface under half of the sections. The plastic filter fabric was Mirafi 140 manufactured by the Celanese Corporation of America. The purpose of the fabric was to determine if it improved the trafficability of the gravel and if it would benefit the cleanup operation. The two bare ground test sections and the gravel sections were plowed by the North Elba Town Highway Department. One bare ground section was plowed all winter and the second section after February 1. Photographs 1 and 2 show portions of the test site.

RESULTS OF TESTS - HORSESHOW GROUNDS, NORTH ELBA

The results of the following test program should be applied only to other potential sites where the soil and drainage conditions are similar - well drained granular soils with a grass cover.

SNOW COMPACTION

The purpose of this test was to determine the feasibility of compacting snow in place to provide a stable parking surface. Mr. Robert Fisher of West Mountain Sales, Inc. provided a Thiokol Hydromaster developed for grooming ski slopes.

PHOTOGRAPH 1 - Gravel Pad Test Sections

PHOTOGRAPH 2 - Sawdust Cover Test Section

The equipment was a vehicle equipped with five foot wide treads for breaking down and densifying the snow and a hydraulic screed for smoothing the snow surface. On January 24 the test was conducted on an initial depth of 22 inches of dry snow. The vehicle compacted the snow to 9 inches. However the snow had no bearing capacity because of its dry condition. On the next day, further attempts to compact the snow with the large pneumatic tires of a front end loader proved impractical. Automobile wheels sunk to the ground surface. On the third day the temperature rose into the 50's and a heavy rain fell. The compacted snow became slush and soon after turned to ice when the temperatures dropped. Further snow compaction operations were not practical after the test area froze.

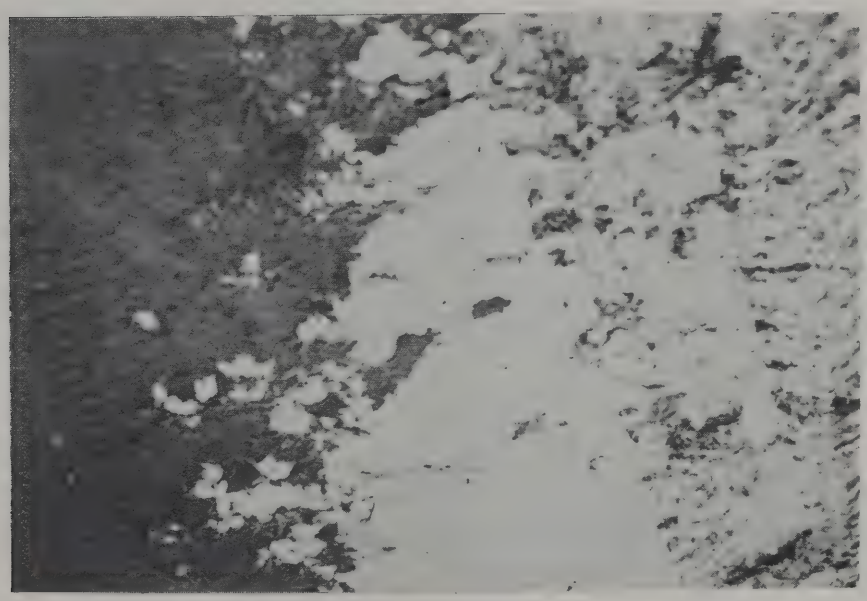
Information from the Corps of Engineers and from the 1958-59 Navy tests at Squaw Valley, California indicated that strength buildup in the snow is obtained by age hardening requiring at least one week. Also moisture in the snow is required for proper compaction. Their experience was obtained working with greater initial snow depths than usually exist in the Lake Placid area.

BARE GROUND

The bare ground provided excellent support for vehicles at temperatures below freezing and also at temperatures above freezing during the day. Automobiles and pickup trucks were driven and parked on the test areas at temperatures above freezing. Observations were made on rutting and traction.

The extended thaw from March 8 to 15 provided the first opportunity to test the areas under critical temperature conditions. A summary of the temperatures and trafficability performance at the North Elba and Keene sites is shown in the following table. Temperature information obtained from the

Atmospheric Science Research Center, Whiteface Mountain Field Station at Marble Lodge is also shown. The performance testing indicated no rutting at North Elba after 7 days of thawing weather and 1/2 inch ruts at Keene after four days of thaw. Photograph No. 3 shows tire imprints on bare-ground and on the gravel pad at North Elba during this time period.



PHOTOGRAPH NO. 3 - Tire imprints on bare ground (left) and gravel pad (right) at N. Elba Test Site

TABLE 1. SUMMARY OF MAXIMUM TEMPERATURES AND BARE GROUND TRAFFICABILITY DURING EXTENDED THAW - MARCH 8 -15, 1978

TEMPERATURE RECORD	MARCH	8	9	10	11	12	13	14	15
Marble Lodge Whiteface Mountain									
MAXIMUM TEMPERATURE		32°	43°	38°	40°	39°	45°	47°	34°
HOURS ABOVE 32°			14	13	14	18	15	23	13
North Elba Test Site									
MAXIMUM TEMPERATURE		42°	50°	50°	Weekend		55°	36°	34°
PERFORMANCE							No Ruts	No Ruts	No Ruts
Marcy Airfield Test Site									
MAXIMUM TEMPERATURE		28°	34°	36°	34°	38°	38°	40°	36°
PERFORMANCE							½"Rut	½"Rut	

A large scale test was provided by parking for the World Games held February 8-13, 1978. The Horseshow track was plowed a week before to accommodate parking on February 12 and 13. The lot was used by 600 to 800 cars on the two days and busses traveled through the area. The daytime temperature was below freezing during this period. No rutting or traction problems were experienced in the parking area. One to two inches of snow fell on each day and it did not affect traction. The soil was the same as the test section except there was no grass cover. Rutting did occur in a localized area on the access road where there was a depression filled with snow.

PHOTOGRAPH NO. 4 - Condition of Parking Surface
at Horseshow ground - World Games Parking

GRAVEL LAYERS

The gravel sections, 6 inches and 12 inches thick, performed equally as well as the bare ground during the test. The gravel did not provide any measurable increase in support as determined from the trafficability testing. The portions underlain by filter fabric performed the same as sections without filter fabric. The gravel sections exhibited rutting at the same time rutting appeared on the bare ground during the March thaw.

SAWDUST

Sawdust is effective as an insulator to prevent thawing of compacted snow or bare ground. On March 15, 1978, a two to three inch layer of sawdust, 10 feet wide, was spread on the gravel, compacted snow, and bare ground test sections. The sawdust adequately supported traffic until the testing was terminated on April 5, 1978. The test section without sawdust became increasingly soft during this period.

CLEANUP OPERATIONS

On May 18, 1978, the sawdust and gravel was removed with a front end loader, a blade grader, and dump trucks. The gravel was removed to the original ground surface without difficulty. In the area underlain by filter fabric the front end loader attempted to remove the gravel without disturbing the fabric. Undulations in the ground surface caused the bucket to catch and tear the fabric at the high spots. As a result, the goal of leaving a clean ground surface in the filter fabric area was not achieved. In order to accomplish this type of cleanup a clamp arrangement would have to be developed for the end of the fabric strip and the gravel removed as the strip was lifted. This method would be costly and time-consuming.

The sawdust was pushed into windrows by a grader. Attempts to remove the sawdust by a front end loader and dump trucks was halted since the ground under the sawdust was extremely wet and soft.

DISCUSSION AND CONCLUSIONS

SNOW COMPACTION

The trial snow compaction was not successful because of the dry condition of the snow. The Corps of Engineers faced with the same problem in Alaska have not found a practical method to add water uniformly to the snow for efficient

compaction. At Squaw Valley the Navy found that standby crews and equipment were required to compact new snow during hours when the lot was vacant and also to spread sawdust 1/2 inch thick to protect the snow when daytime temperatures went above freezing. Specialized compaction equipment consisting of large diameter drum rollers, vibratory rollers, and pulvimixers was used. The preparation of compacted snow for parking areas requires careful and time-consuming techniques. Standby crews and equipment are required to maintain surfaces after useage and during and after thaw conditions. There is a definite possibility that warm weather could cause softening of the snow with undesirable results. Snow compaction is not recommended as a feasible alternative for the parking area surfaces.

BARE GROUND

Frozen ground provides adequate support, strength and trafficability for a parking lot operation. The area should be plowed at least four weeks before use to insure good frost penetration. When the temperature remains below 32° there should be no problems. In March 1978, daily high temperatures between 34° and 40° occurred on four consecutive days before rutting was observed. The depth of ruts were 1/2 inch. It is possible that in the roadway areas (access roads and parking lanes) where repetitive wheel load applications will occur, the surface will rut and become muddy sooner at above freezing temperatures. This condition was not investigated in the tests. Any localized depressions that cannot be cleared with a plow blade will be filled with snow and could become a rut under thaw conditions or at below freezing conditions under repetitive wheel loads. The site preparation should include mowing all grass short and filling local depressions with available sand or gravel material to provide a reasonable smooth surface for

plowing. Bare ground is a practical method to use for the parking areas provided that the subsurface soil is granular and well drained.

SAWDUST APPLICATION

Sawdust is a very effective insulating material. The 2 to 3 inch layer at the test sites provided adequate traffic support into the middle of May. It is possible that a one inch layer may be adequate to protect the parking area access drives traversed by automobiles. Further investigation should be made into the techniques used for spreading sawdust efficiently. On the test site a front-end loader was used. It was the opinion of the equipment operator that closer grading control could be achieved by removing the bucket teeth. At Squaw Valley the sawdust was spread by a farm fertilizer spreader and a lime spreading attachment. Sideboards were used to increase the capacity of the storage box.

Sawdust is available from at least five sources in the Lake Placid area. However, the available supply is usually purchased by loggers who also realize the benefits of sawdust in maintaining winter roads and by farmers for bedding for animals. Therefore the material will have to be purchased and stockpiled prior to use. The sawdust purchased in 1978 cost 5¢ per cubic foot or $1.35 per cubic yard plus trucking. Stockpiles should be covered to keep the sawdust as dry as possible for efficient spreading. One large stockpile should be made in each parking area to minimize volume losses due to surface freezing. Plowing snow without removing the sawdust can be accomplished by using shoes to raise the blade.

GRAVEL LAYER

The test indicated that gravel and bare ground provided equally adequate support when frozen. However gravel should be considered for bus access roads

because of heavy repetitive wheel loads. The gravel may be graded to provide a smooth surface for the frequent and faster moving bus traffic. The thickness of gravel should be a minimum of six inches. Under thaw or rain conditions the surface of the gravel may become softened and muddy. A one inch application of sawdust at the start of operations should prevent the loading areas from becoming muddy and prevent development of washboard rutting on the roadways carrying heavy bus traffic.

OTHER TYPES OF SURFACING

More elaborate surfaces such as asphalt concrete or soil cement stabilization will be expensive to construct and remove. The performance of frozen ground indicates that these treatments will not be necessary. Metal landing mats used by the military may also be considered. Mats would adequately serve to carry traffic under temporary thaw conditions and eliminate the need for sawdust. The volume supply of the mats is a logistic problem that would have to be worked out with the appropriate military service.

ENVIRONMENTAL AND SITE RESTORATION CONSIDERATIONS

While the lots are in operation it is expected that there will be minor amounts of oil, gasoline, salt and soil deposited by the vehicles. The minor concentrations of oil, gasoline and salt should be diluted by subsequent rain and leached into the ground without adverse effects on grass growth. Where sawdust is used these drippings will be absorbed by the sawdust.

The cleanup operations at the test site indicated that a reasonably clean ground surface can be achieved by careful removal of the gravel. A rotary broom sweeper mounted on a tractor was used in the final cleanup operation. It will be difficult to remove the gravel and sawdust until the material has thawed and the ground surface can support equipment without rutting.

There will be some residual sawdust mixed in with the grass surface. The decomposition process creates a high nitrogen demand which will cause yellowing and thinning of the grass. This can be prevented by applying a high nitrogen fertilizer early in the spring. This fertilizer will hasten decomposition of the sawdust and make nitrogen available to the existing grass. The area should be reseeded as needed with an appropriate grass seed mixture at the time of fertilization.

EVALUATION OF POTENTIAL SITES

The Olympic Transportation Committee has identified a number of potential sites for proposed peripheral parking. These sites are located along the three major transportation corridors into the Lake Placid area. The Soil Mechanics Bureau of the Department of Transportation was requested to evaluate the soils and drainage conditions at these sites. A summary of the investigation is included in Appendix C.

The stability of the ground surface for parking requires a granular soil with good drainage. Under these conditions frost will penetrate to an adequate depth for support. In areas with thick topsoil and a high water table, the frost will not penetrate and the support capacity will be marginal.

All of the previous site testing was performed on well drained granular soil. The test site results do not apply to poorly drained areas. If a site having poor drainage and thick topsoil is being seriously considered, then additional field testing should be done during the winter of 1978-79 to determine what additional treatment will be required.

RECOMMENDATIONS

The final strategy for the design of the temporary parking area surfaces will be influenced by the economics of the project and the degree of conservatism placed upon the amount of treatment to offset the deterioration of parking and access road surfaces under the worst thaw conditions that could occur during use.

Based upon information and experience obtained from the 1977-78 test program the principal recommendations for sites located on well drained granular soil with grass cover are:

1. Automobiles may be parked on plowed bare ground.
2. Access lanes for automobiles may be on plowed bare ground covered with one inch of sawdust.
3. Access roads for busses and bus loading areas should be provided with a minimum of 6 inches of compacted well graded sand and gravel covered with one inch of sawdust.
4. Compacted snow surfaces should not be considered.

Some potential sites are on poorly drained soils with a high water table and thick topsoil. In these locations more elaborate site preparation may be required to provide adequate support. If any of these sites may be selected, it is recommended that in the winter of 1978-79 additional tests be conducted to determine the extent of treatment required. A possible treatment is a sand and gravel layer over the entire site.

Additional site preparation, operation, and restoration recommendations are as follows:

1. In the fall, clear site of all brush and mow grass as short as possible.
2. Fill with sand or gravel all minor depressions that could be bridged by plow blade.

3. Determine the most efficient and practical method of spreading sawdust in a one inch layer during the next year.
4. Parking areas should be plowed to bare ground at least one month before use to insure adequate frost penetration.
5. During operation of lot, plows should be equipped with shoes to allow snow removal with minimum disturbance of sawdust.
6. Additional applications of sawdust may be required during use.
7. Obtain adequate sawdust supply in advance because of market demand. A single covered stockpile should be maintained at each site.
8. Cleanup of gravel and sawdust should be done after ground thaws and becomes stable. Sand and gravel in small depressions may be left.
9. Apply a high nitrogen fertilizer to the gravel and sawdust areas early in the spring. Reseed where needed with an appropriate seed mixture.

ACKNOWLEDGMENTS

The test site project for peripheral parking areas was done under the direction of the Olympic Transportation Committee.

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Informal technical assistance and information was provided by

U. S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire

West Mountain Sales, Inc. of Glens Falls, New York

National Oceanic and Atmospheric Administration

APPENDIX A

SUMMARY OF SNOW COMPACTION TECHNOLOGY

SNOW COMPACTION

One of the alternates that was investigated for the winter parking surfaces was snow compaction. A literature search was conducted for available information. Two reports prepared by U. S. Naval Civil Engineering Research and Evaluation Laboratory, Port Hueneme, California were reviewed. This organization conducted field projects for compacted-snow parking lots at Squaw Valley, California prior to the 1960 Winter Olympics. Summaries of these reports are included in this appendix.

The U. S. Army Corps of Engineers Cold Region Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire has been active in the development of procedures for compacting snow roads and airfield runways in Alaska. In October 1977 representatives from the Soil Mechanics Bureau and Olympic Transportation Committee visited the CRREL offices to discuss their experiences and solicit their advice on the test site program at Lake Placid. A summary of the information learned is included in this appendix.

1. Technical Report R-009, Squaw Valley Winter Trials 1957-58, Compacted-Snow Parking Lot Study, NY 000 013-1.01, Sept. 1958, U. S. Naval Civil Engineering Research & Evaluation Laboratory, Port Hueneme, California.

   This project was directed towards the development of snow compaction equipment and techniques for use in Polar Regions and also to serve the needs of the California Olympic Commission. A small parking lot was constructed on a five foot snow pack of moderately wet snow in mid-February using a pulvimixer to pulverize and mix the existing snow. Compaction was accomplished by an 8 ft. diameter steel roller and a pneumatic-tired roller. Successful

compaction requires high snow moisture content during compaction and cold air temperatures during hardening.

During March the parking lot was used by cars and busses on six occasions. Maintenance was required to provide an adequate surface for traffic during heavy rains, high solar radiation, new snowfalls, and long warm spells. It was found that a 1/2 inch surface cover of sawdust preserved the compacted-snow mat during the periods of adverse temperature conditions. The sawdust contributed to better traction and safe-driving conditions.

2. Technical Report 051, Squaw Valley Winter Trials 1958-59, Compacted-Snow Parking Study on Meadow Land, U. S. Naval Civil Engineering Laboratory, Port Hueneme, California.

This report contains the problems involved in providing a compacted-snow parking area for 2000 cars (15 acres) for the North American Olympic Trails in February 1959 and training the nucleus of a construction battalion personnel in snow compaction techniques. The area designated was poorly drained meadowland with numerous springs. The results indicated that a compacted-snow surface could be constructed on this unfavorable terrain with an 18 inch compacted snow cover, with night time temperatures below freezing, and if the area is protected against runoff water from the surrounding area. Heavy rainfalls required 48 hour delays before the snow surface could be recompacted.

Sawdust layers 1/2 inch thick were found to be effective in preserving the snow surface under thaw temperatures. The sawdust

was applied with a farm fertilizer spreader with a lime-spreading attachment. Sideboards were used to increase the capacity of the spreader. A report recommendation was made to improve the equipment for spreading sawdust in order to provide faster coverage and more even sawdust distribution. A sawdust cover on the snow was essential on days when the temperature was above freezing. On one occasion the sawdust spreader broke down and the lot had to be closed for several hours until the spreader was repaired.

3. Meeting with U. S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, October 1977.

Engineers from the Snow Roads and Airfields Unit provided information on their experiences with snow compaction and is summarized below.

1. Compacted snow surfaces

   a. Ground must be frozen. Meadow areas with high groundwater and deep topsoil have low frost penetration and should be avoided. Best frost penetration is in well drained granular soils.

   b. Compaction requires breaking down the snow structure and rolling with increasing pressures. Strength is obtained through age hardening requiring at least one week. Age hardening is faster at temperatures of 0° to $32^{o}F$ and slower at less than $0^{o}F$, however the final strength is

greater at less than $0^{o}F$. After a surface has been developed it is best to remove all new snow during the period of lot operation. A long narrow strip is most efficient for snow removal. Vibratory compaction at slow speed works only in dry snow. A corrugated roller works for 1 to 2 feet of snow. Preparation of lot should start four to six weeks ahead of time of use.

c. All brush and long grass should be removed prior to snowfall.

d. The trail area for compaction should be large enough to require two days to process and compact. The daily variation of temperature is an important factor in process.

2. Use of sawdust to preserve snow surface

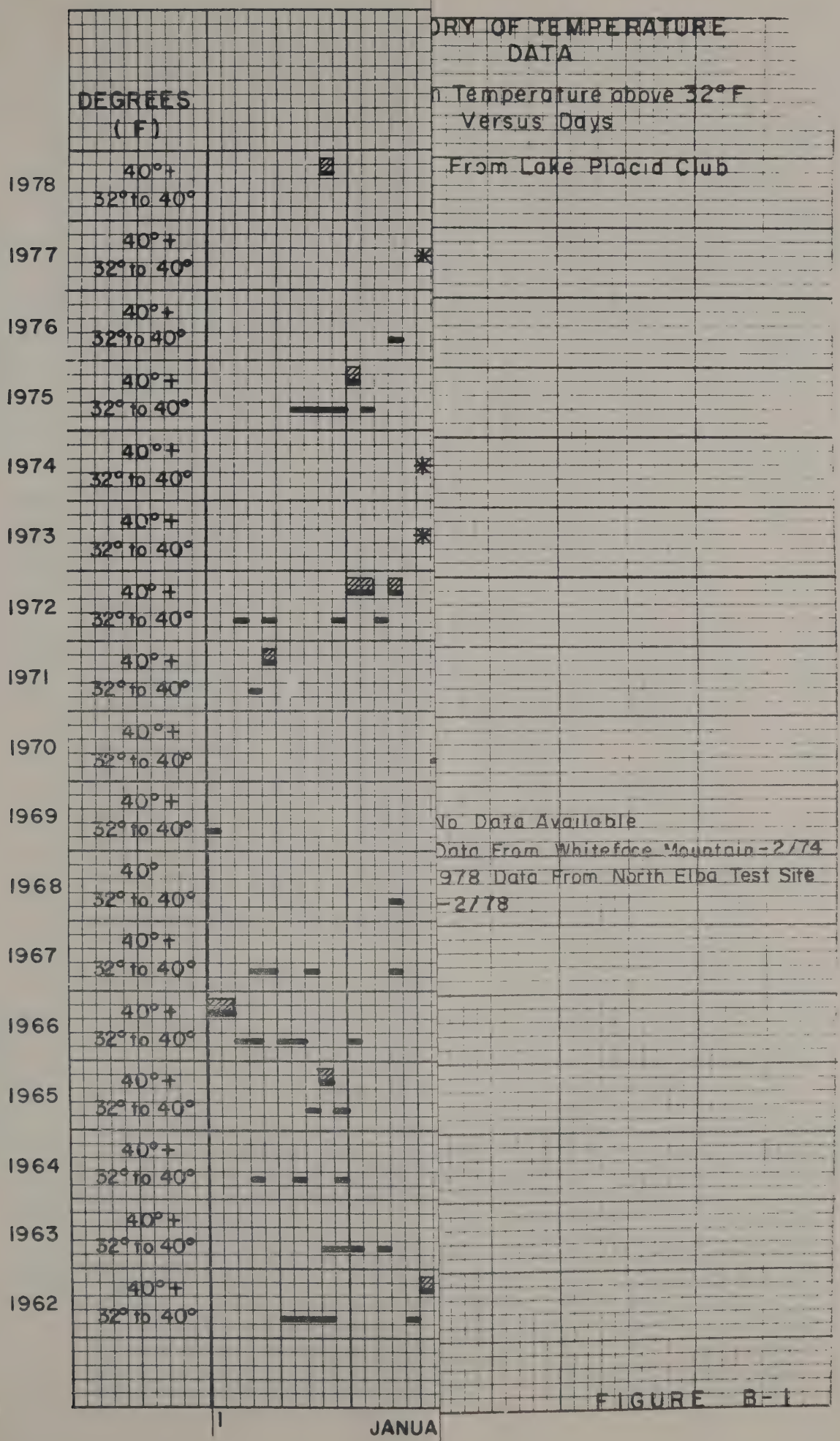
Sawdust was used very successfully in Alaska to lengthen the life of snow roads. The roads were in use long after the spring thaw had destroyed other compacted snow surfaces. Sawdust was mixed into the top three inches of the snow. A rotary plow made windrows of snow, the sawdust was spread on the windrows, and a bulldozer mixed the sawdust and snow as it was placed on the road.

3. Mixing water with snow to increase strength

This is an obvious solution but has been found difficult to perform in Alaska. An asphalt distributor truck with heated tank and special spray bar was used. Lack of uniform surface strength and equipment problems were the principal troubles.

APPENDIX B

CLIMATE DATA


DRY OF TEMPERATURE
DATA
n Temperature above 32° F
Versus Days
From Lake Placid Club
DEGREES
(F)
1978
40°+
32° to 40°
1977
40°+
32° to 40°
1976
40°+
32° to 40°
1975
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32° to 40°
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32° to 40°
1964
40°+
32° to 40°
1963
40°+
32° to 40°
1962
40°+
32° to 40°
No Data Available
Data From Whiteface Mountain - 2774
978 Data From North Elba Test Site
- 2778
1
JANUA

FIGURE B-1

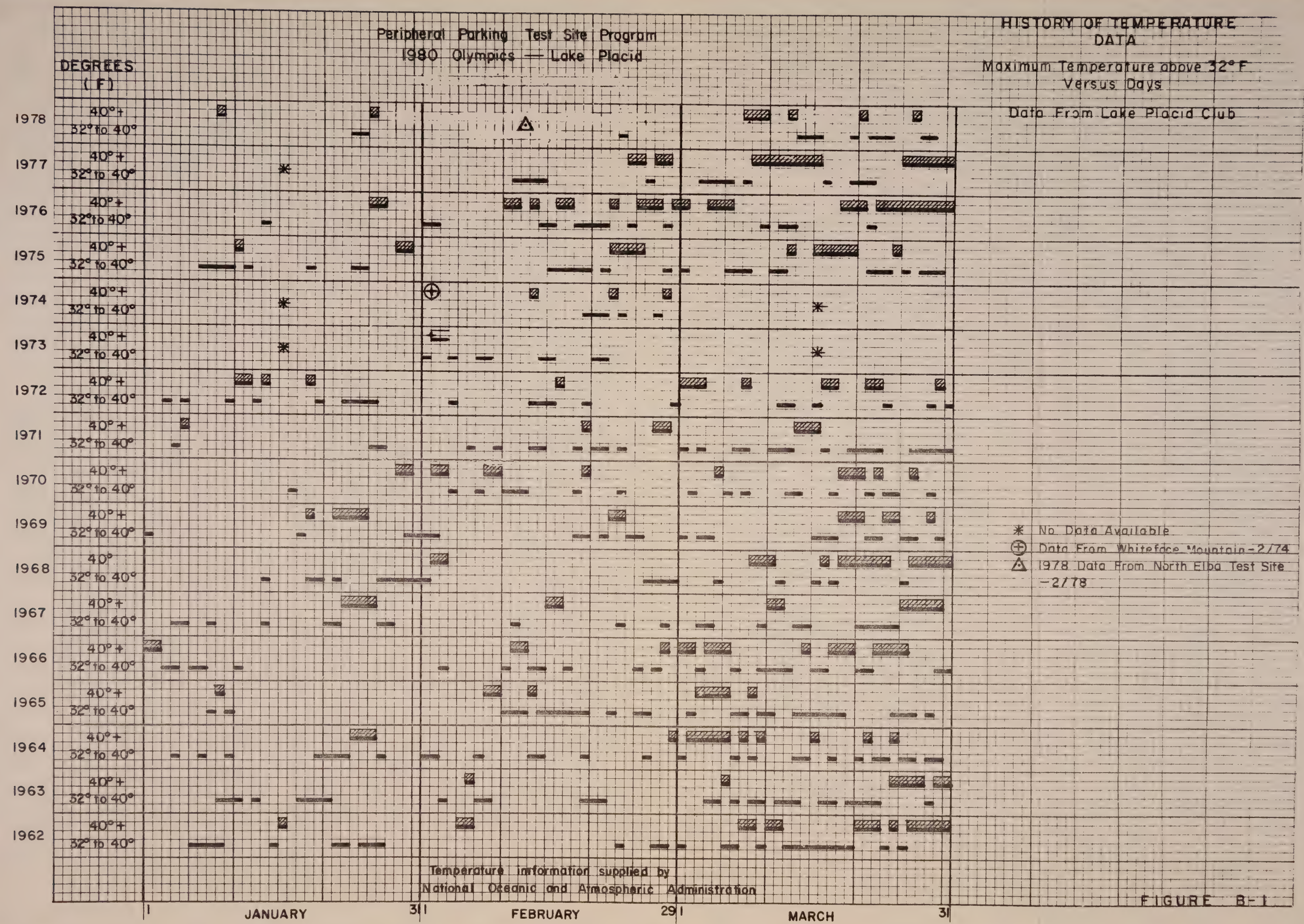

Peripheral Parking Test Site Program
1980 Olympics — Lake Placid
HISTORY OF TEMPERATURE DATA
Maximum Temperature above 32° F
Versus Days
Data From Lake Placid Club
DEGREES (F)
40°+
32° to 40°
1978
1977
1976
1975
1974
1973
1972
1971
1970
1969
1968
1967
1966
1965
1964
1963
1962
No Data Available
Data From Whiteface Mountain - 2/74
1978 Data From North Elba Test Site - 2/78
Temperature information supplied by
National Oceanic and Atmospheric Administration
1
JANUARY
31
1
FEBRUARY
29
1
MARCH
31

FIGURE B-1

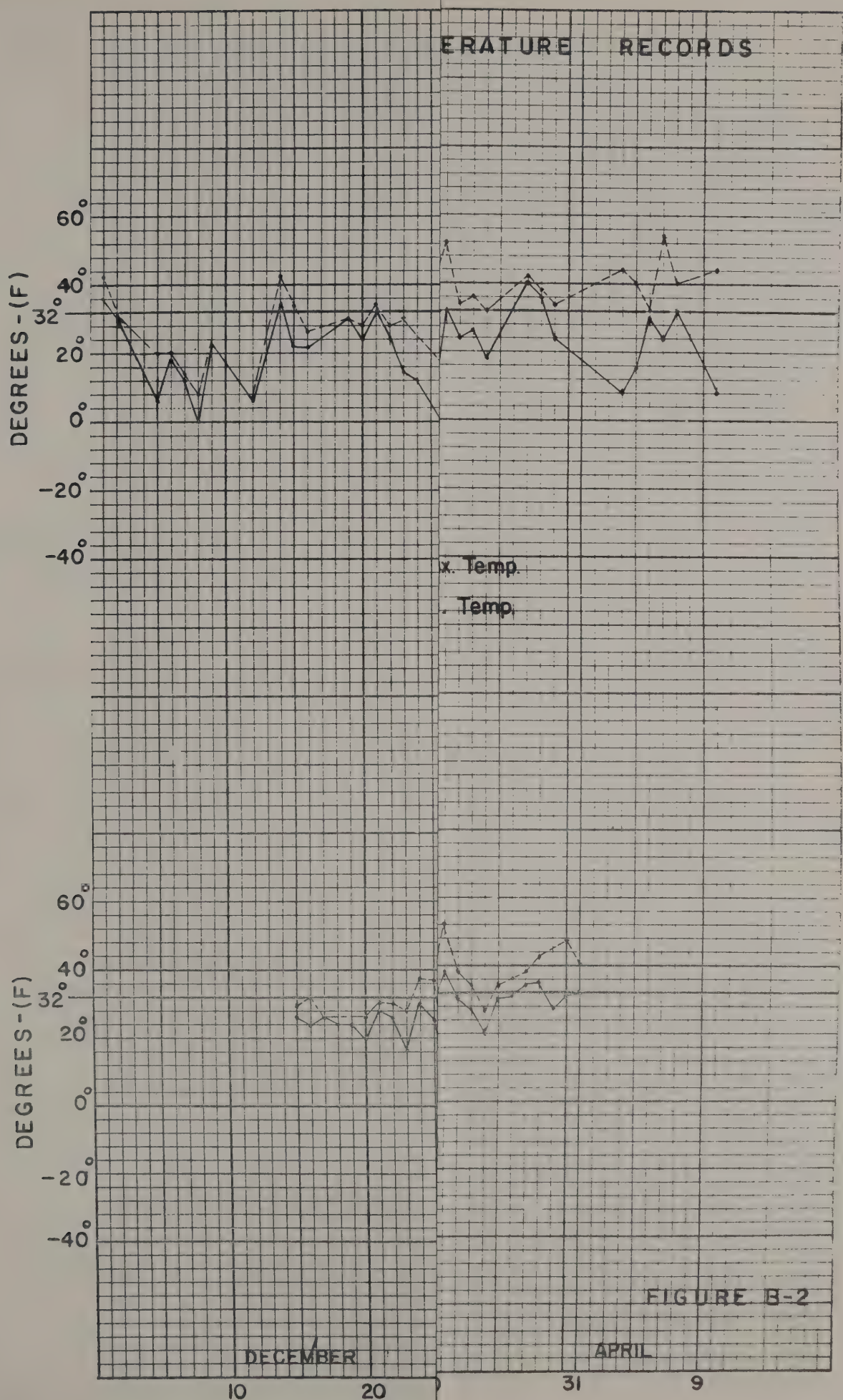

ERATURE RECORDS
60°
40°
32°
20°
0°
-20°
-40°
DEGREES-(F)
x. Temp.
. Temp.
60°
40°
32°
20°
0°
-20°
-40°
DEGREES-(F)
DECEMBER
APRIL
10
20
31
9

FIGURE B-2

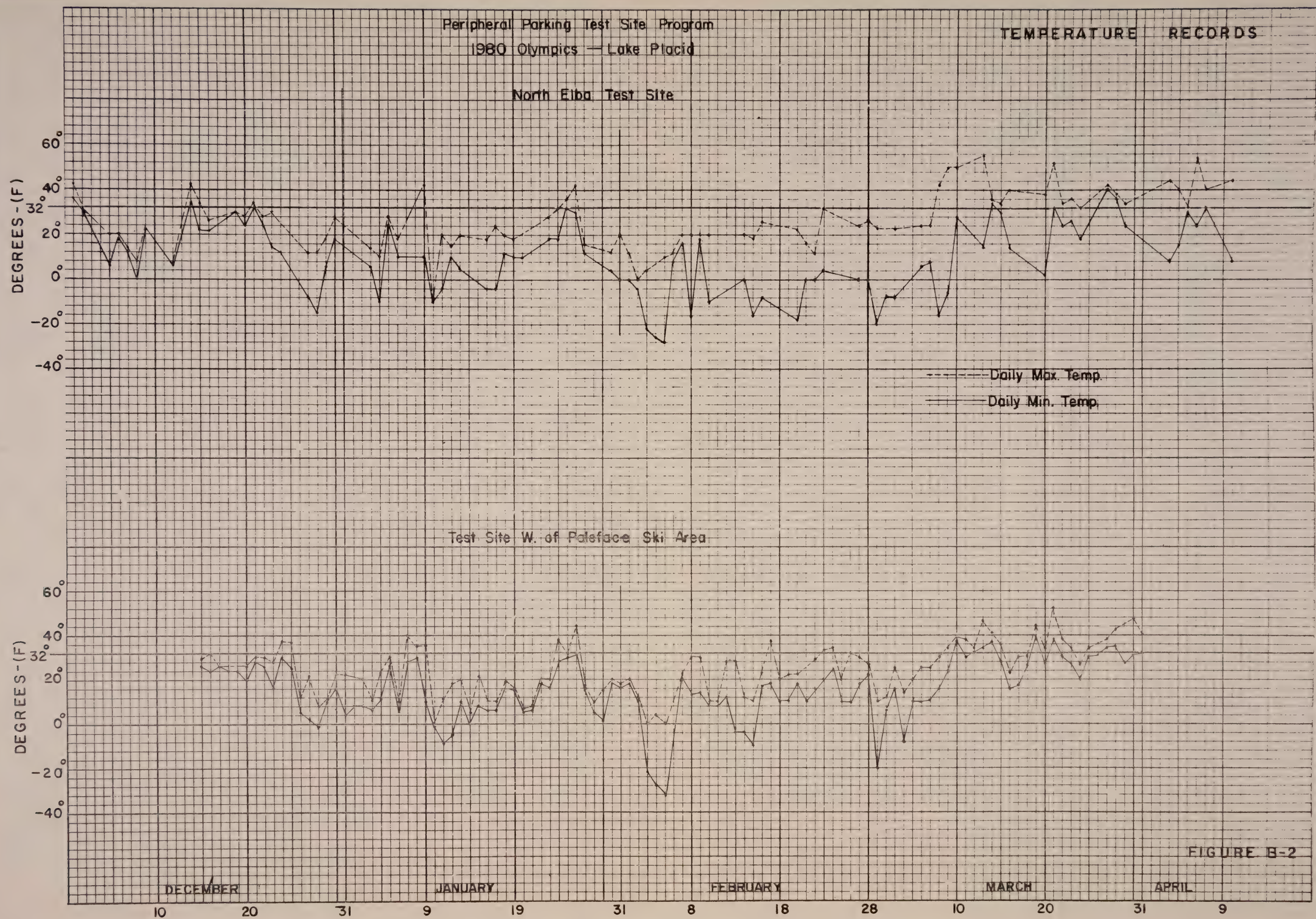

Peripheral Parking Test Site Program
1980 Olympics — Lake Placid
TEMPERATURE RECORDS
North Elba Test Site
DEGREES-(F)
60°
40°
32°
20°
0°
-20°
-40°
Daily Max. Temp.
Daily Min. Temp.
Test Site W. of Paleface Ski Area
DEGREES-(F)
60°
40°
32°
20°
0°
-20°
-40°
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
10
20
31
9
19
31
8
18
28
10
20
31
9

FIGURE B-2

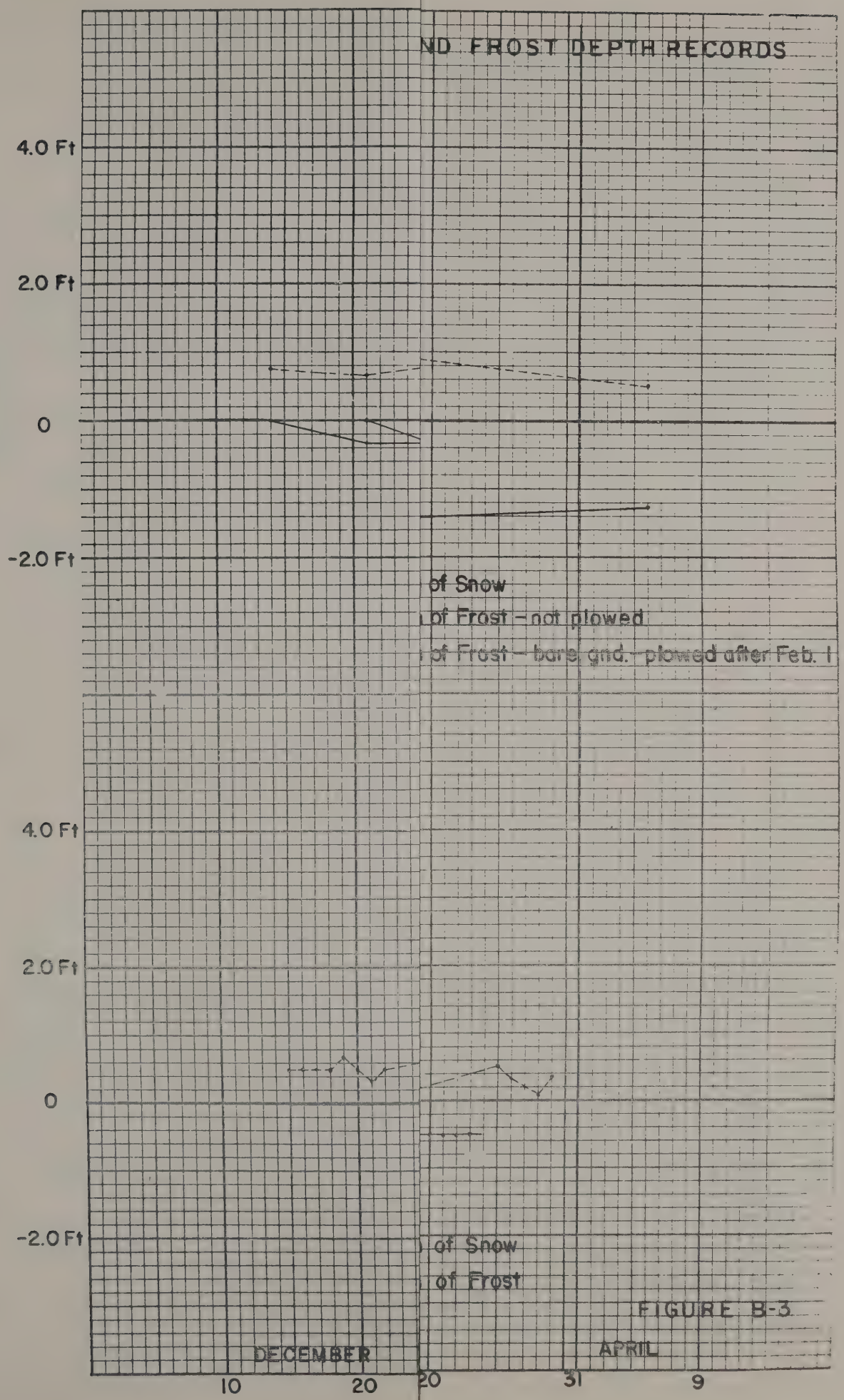

ND FROST DEPTH RECORDS
4.0 Ft
2.0 Ft
0
-2.0 Ft
of Snow
of Frost – not plowed
of Frost – bare gnd. – plowed after Feb. 1
4.0 Ft
2.0 Ft
0
-2.0 Ft
of Snow
of Frost
DECEMBER
APRIL
10
20
20
31
9

FIGURE B-3

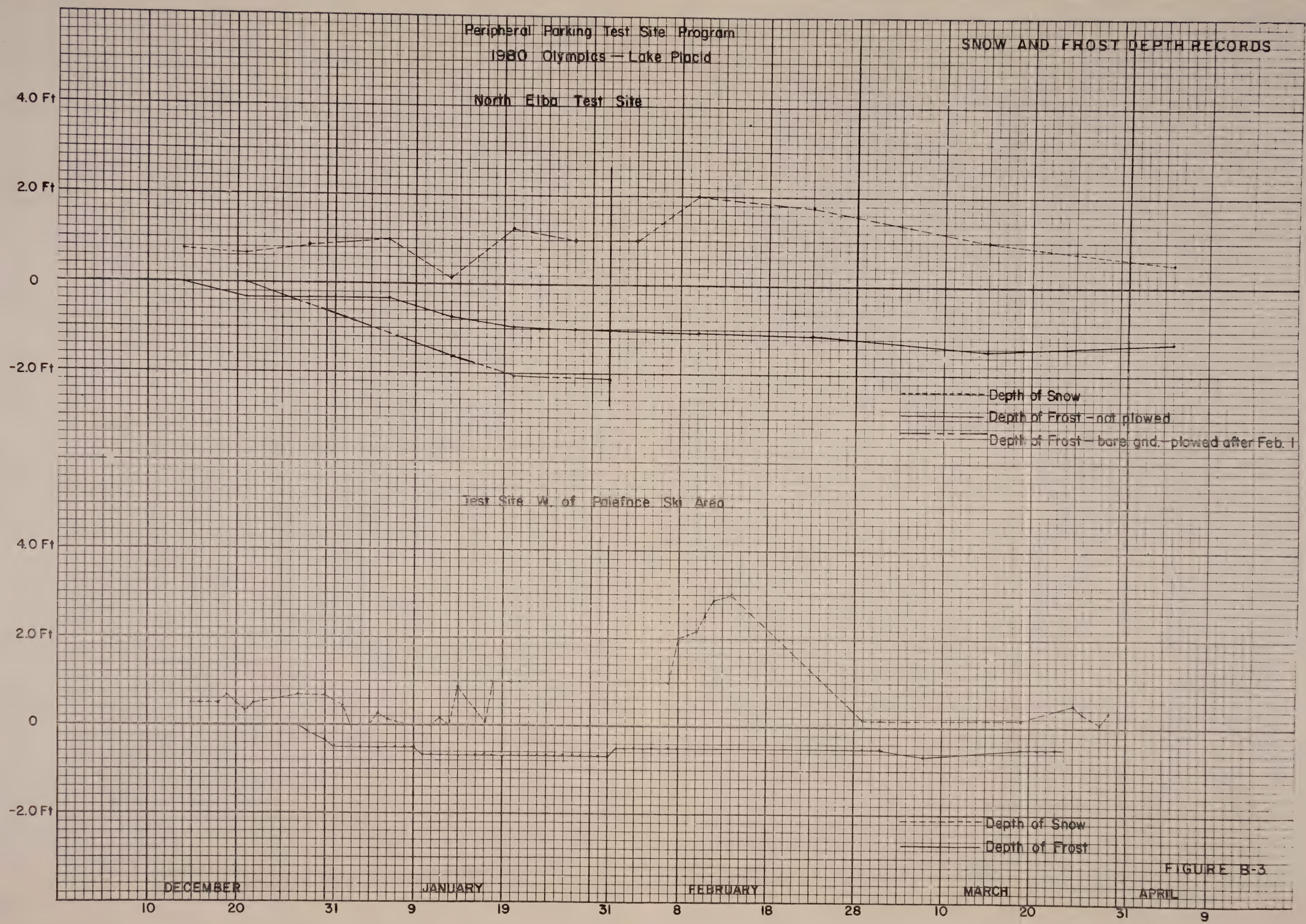

Peripheral Parking Test Site Program
1980 Olympics — Lake Placid
SNOW AND FROST DEPTH RECORDS
North Elba Test Site
4.0 Ft
2.0 Ft
0
-2.0 Ft
Depth of Snow
Depth of Frost – not plowed
Depth of Frost – bare gnd. – plowed after Feb. 1
Test Site W. of Poleface Ski Area
4.0 Ft
2.0 Ft
0
-2.0 Ft
Depth of Snow
Depth of Frost
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
10
20
31
9
19
31
8
18
28
10
20
31
9

FIGURE B-3

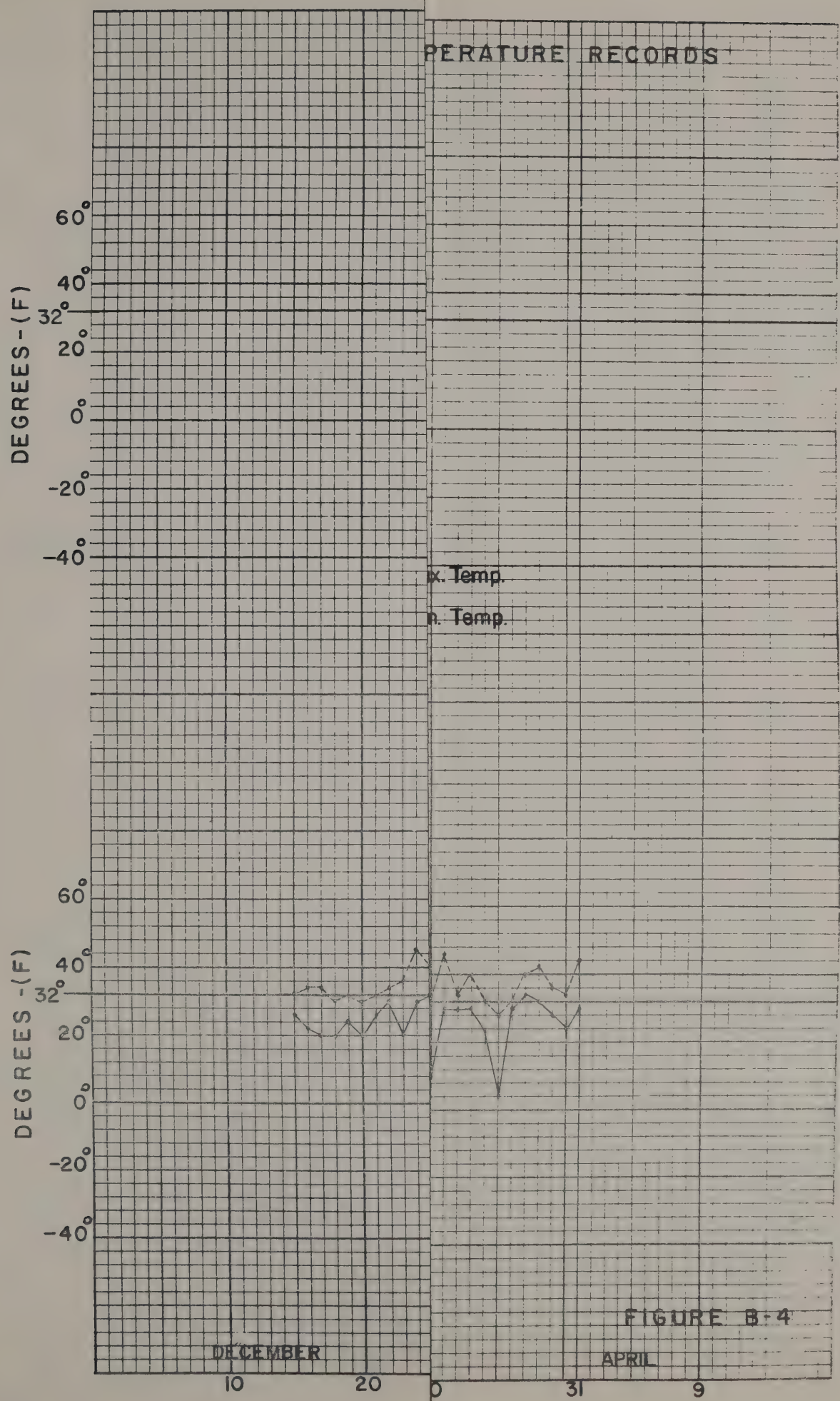

PERATURE RECORDS
DEGREES-(F)
60°
40°
32°
20°
0°
-20°
-40°
x. Temp.
n. Temp.
DEGREES-(F)
60°
40°
32°
20°
0°
-20°
-40°
DECEMBER
10
20
0
31
9
APRIL

FIGURE B-4

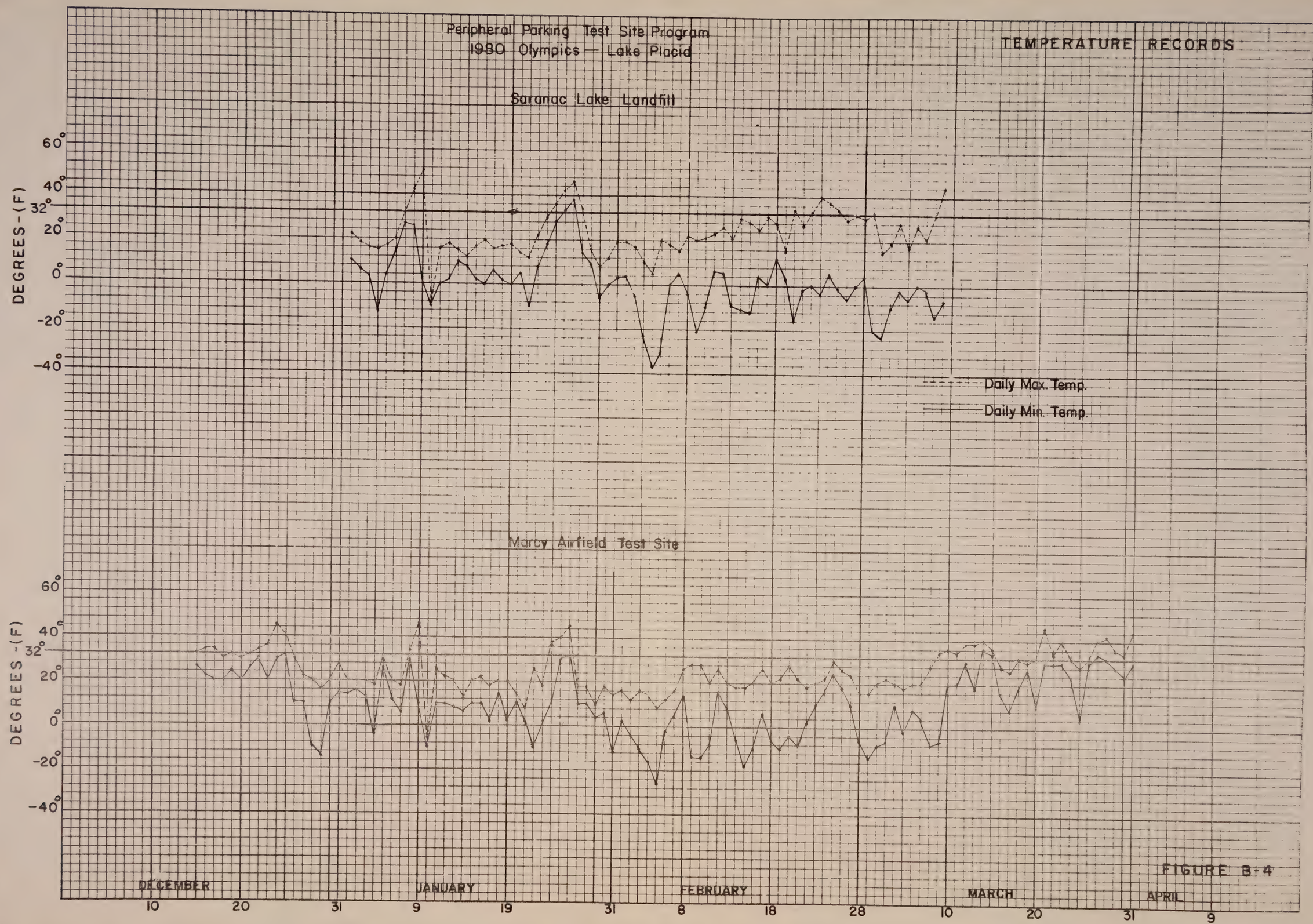

Peripheral Parking Test Site Program
1980 Olympics — Lake Placid
TEMPERATURE RECORDS
Saranac Lake Landfill
DEGREES - (F)
60°
40°
32°
20°
0°
-20°
-40°
Daily Max. Temp.
Daily Min. Temp.
Marcy Airfield Test Site
DEGREES - (F)
60°
40°
32°
20°
0°
-20°
-40°
DECEMBER
10
20
31
JANUARY
9
19
31
FEBRUARY
8
18
28
MARCH
10
20
31
APRIL
9

FIGURE B-4

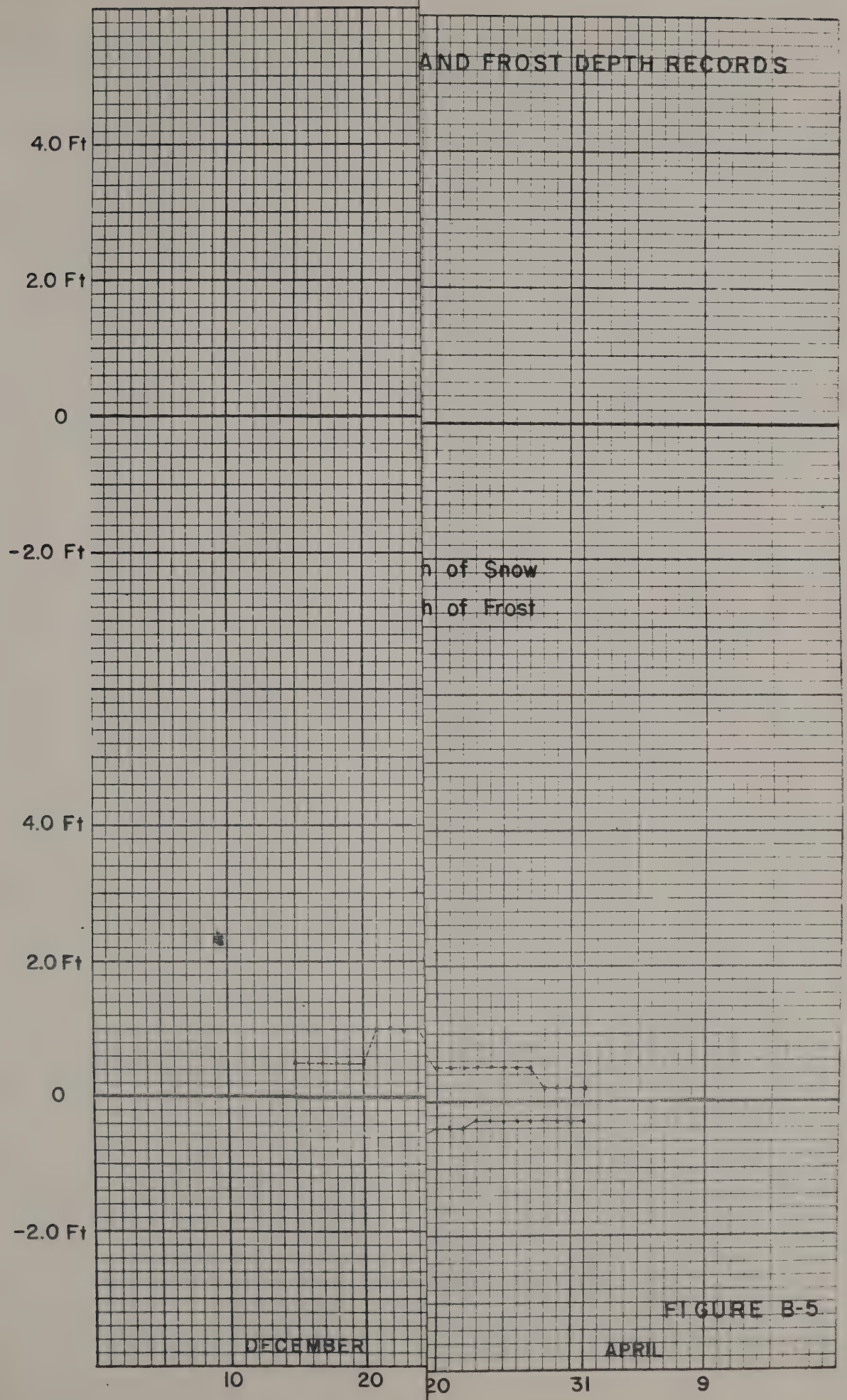
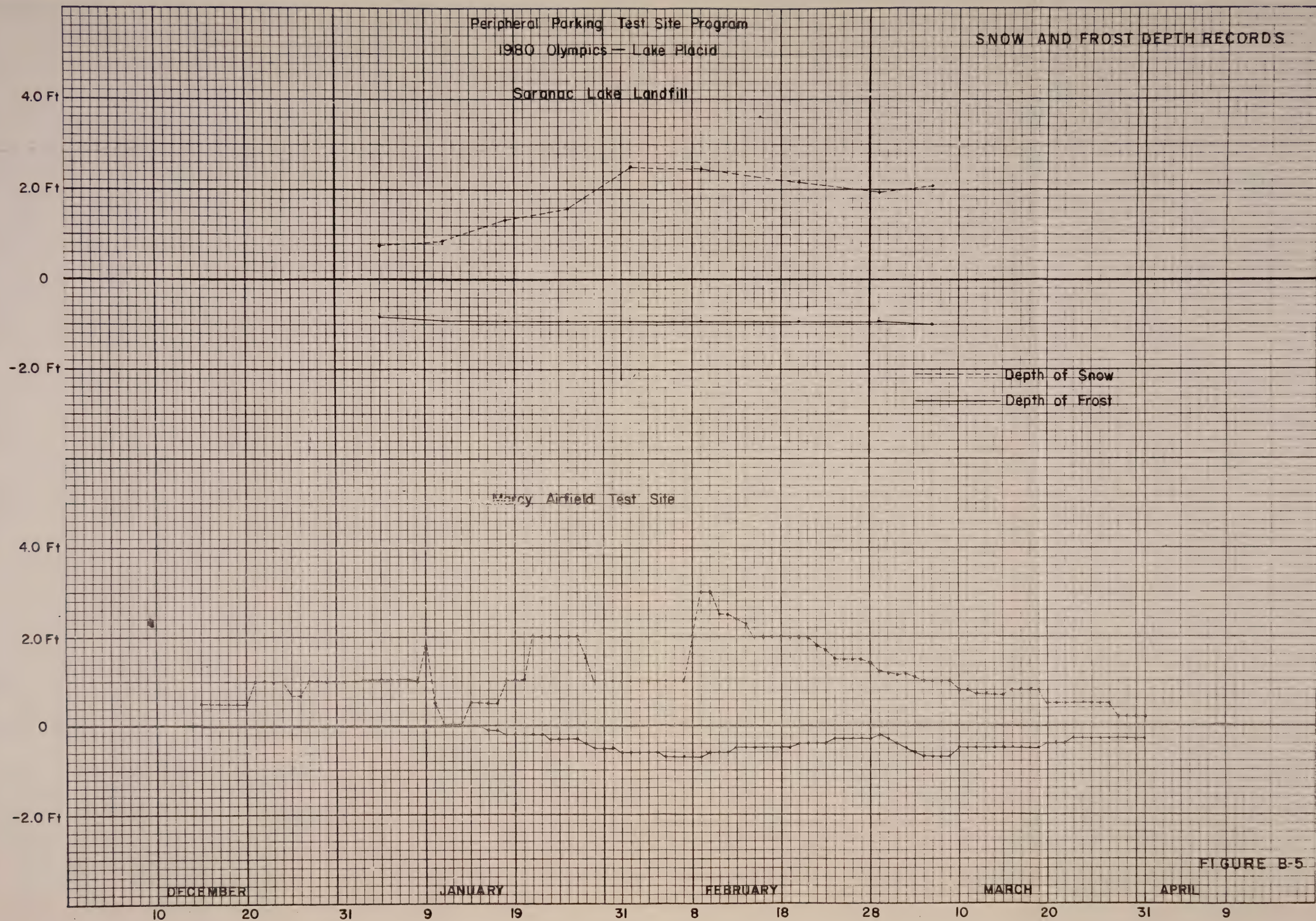

AND FROST DEPTH RECORDS
4.0 Ft
2.0 Ft
0
-2.0 Ft
h of Snow
h of Frost
4.0 Ft
2.0 Ft
0
-2.0 Ft
DECEMBER
APRIL
10
20
20
31
9

FIGURE B-5


Peripheral Parking Test Site Program
1980 Olympics — Lake Placid
SNOW AND FROST DEPTH RECORDS
Saranac Lake Landfill
4.0 Ft
2.0 Ft
0
-2.0 Ft
Depth of Snow
Depth of Frost
Mercy Airfield Test Site
4.0 Ft
2.0 Ft
0
-2.0 Ft
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
10
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31
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18
28
10
20
31
9

FIGURE B-5

APPENDIX C

EVALUATION OF POTENTIAL SITES

XIII WINTER OLYMPIC GAMES - 1980
LAKE PLACID, NEW YORK

SOIL EVALUATION OF PROPOSED PERIPHERAL PARKING AREAS

SITE	ROUTE	LOCATION	SIZE	TOPOGRAPHY	SOIL UNIT	DRAINAGE	TOPSOIL DEPTH	RELATIVE GEOMETRICS	CURRENT AREA USAGE	RATING FROM SOILS STANDPOINT
South Travel Corridor										
*Lot S1	73	Marcy Airfield	70 acres	Level	1	Well drained	12 inches-	Area same elevation as Route 73	Grass covered	Good
Lot S2	73 & 9N	West of Intersection	40 acres	Level	1	Well drained	18 inches±	Area 8 to 10 feet below Route 73, Ramps necessary	Heavy grass cover	Poor
Lot S3	73	North side, 0.4 mi. East of Mt. VanHoevenburg Access road	30 acres	Slightly rolling	2	Well drained	9 inches±	Area same elevation as Route 73	Heavy grass & brush	Good
North Travel Corridor										
Lot N1	86	South side west of Paleface Ski Center	100 acres	Level	1	Poorly drained	12 inches+	Area same elevation as Route 86	Grass, not used as hay field suggesting wet condition year round	Poor
*Lot N2	86	NW of Rte. 86 & Kilburn Rd. 1.7 mi. east of Wilmington	40 acres	Level	3	Well drained	Thin top-soil	Area same elevation as Route 86	Pasture w/several large surface boulders	Good
*Lot N3	9N	East side, 1.1 mi. NE of Jay	20 acres	Level, but two slightly different elevations exist	1	Well drained	12 inches-	Area below Rte. 9N	Upper elevation-grass covered w/several large surface boulders - Lower elevation-grass covered sand	Good
*Lot N4	9N	North side, 3 mi. NE of Jay	30 acres	Level	1	Well drained	Thin top-soil	Area same elevation as Route 9N	Grass covered w/occasional large surface boulders	Good
Lot N5	9N	East side, 0.8 mi. SW of Jay	30 acres	Level	1	Well drained	12 inches±	Area 10+ feet below Route 9N. Entrance must cross large drainage ditch	Planted with corn, topsoil exposed	Poor
Lot N6	9N	East side, 1.5 mi. SW of Jay	20 acres	Level	1	Northern half-well drained Southern half-poor drained	12 inches+	Area 5± feet below Route 9N	Northern half grass covered Southern half planted with corn	Poor
Lot N7	9N	West side, 2.1 mi. SW of Jay	20 acres	Level with wet swale in center	1	Poor	12 inches-	Area 5+ feet above Route 9N	Grass covered	Poor
West Travel Corridor										
*Lot W1	3	Saranac Lake Middle School	600± vehicles	Level	3	Well drained	6 inches±	Area same elevation as village streets	Grass covered atheletic fields	Good
*Lot W2	3	Saranac Lake High School	500± vehicles	Level	3	Well drained	6 inches±	Area same elevation as village streets and Route 3	Grass covered school grounds w/occasional large surface boulder	Good
Lot W3	86	Off Co. Rd. 33, 1.3 mi. NW of Rte. 86 inter-section	16 acres	Level	4	Well drained	6 inches±	Area 10 to 15 feet above Co. Rd. 33	Wooded, a small part being cleared by a gun club	Good

* Best sites in each corridor

Soil Unit: 1 Hadley - Winooski - Limerick, Alluvial deposits
2 Becket - Skerry, Sandy Glacial Till
3 Hermon - Becket, Sandy Glacial Till
4 Adams, Deep Glacial Lake Sands

SHEET 1 OF 2

Soil Mechanics Bureau OCT 1977

XIII WINTER OLYMPIC GAMES - 1980
LAKE PLACID, NEW YORK

SOIL EVALUATION OF PROPOSED PERIPHERAL PARKING AREAS
(SUPPLEMENTAL LISTING)

SITE	ROUTE	LOCATION	SIZE	TOPOGRAPHY	SOIL UNIT	DRAINAGE	TOPSOIL DEPTH	RELATIVE GEOMETRICS	CURRENT AREA USAGE	RATING FROM SOILS STANDPOINT
South Travel Corridor										
*Lot S4	73	Keene Valley High School	13 Acres	Level	5	Well drained	6 inches ±	Area same elevation as access road	Parking, athletic field	Good
*Lot S5	9N	3.5 mi. west of Elizabethtown	100 Acres	Level	5	Well drained	6 inches ±		Heavy grass and brush	Good
Lot S6	73 & 9N	NE Quadrant	NA	Level	1	Poorly drained	12 inches ±		Grass covered	Poor
Lot S7	73	Alstead Road	NA	Level	1	Poorly drained	12 inches ±		Hayfield	Poor
*Lot S9	9	3.5 mi. south of I-87 Exit 30	NA	Level	5	Well drained	>12 inches	Area same elevation as Rte. 9	Heavy grass and brush	Good
North Travel Corridor										
Lot N10	86	CR 19A North of Wilmington	NA	Level	3	Poorly drained	12 inches ±		Eastern half grass covered Western half grass and brush covered with occasional boulders	Poor
*Lot N12	86	Northwest corner of Route 86 & Kilburn Road 1.7 mi. east of Wilmington	NA	Level	3	Well drained	6 inches ±		NA	Good
West Travel Corridor										
*Lot W2A	3	Saranac Lake High School (Ball Field)	4+ Acres	Level	5	Well drained	Thin Topsoil	Area same elevation as access streets	Athletic field	Good
*Lot W4	3	Madden's Transfer Saranac Lake	NA	Multi Level	5	Well drained but backslopes 15'-20' high are wet in summer	>12 inches	Area same elevation as access streets	Equipment storage area	Good
*Lot W7	86	No. County Community College	NA	Multi Level	5	Well drained	>12 inches	Many areas between buildings higher than access streets	Parking, athletic field	Good
*Lot W8	3	Pius Hall Saranac Lake	4+ Acres	Level	5	Well drained	>12 inches	Area same elevation as access streets	Athletic field and brush	Good
Lot W9	3	Ampersand Bay Road	5+ Acres	Level	5	Well drained	Thin Topsoil	Area same elevation as access streets	Bouldery sand till fill area	Fair

* Best sites in each corridor

Soil Unit: 1 Hadley - Winooski - Limerick, Alluvial deposits
3 Hermon - Becket, Sandy Glacial Till
5 Colton Sand, Sandy Glacial Till